

Title: Stand Up and Be Counted!

Brief Overview:

In this learning unit, students will explore plant populations and the dynamics of those populations. They will use the data they have gathered to compare it to data that they have collected for human populations in a surrounding area. They will use these models to come to conclusions about the effects of populations on an area.

Links to NCTM 2000 Standards:

- **Mathematics as Problem Solving, Reasoning and Proof, Communication, Connections, and Representation**

These five process standards are threads that integrate throughout the unit, although they may not be specifically addressed in the unit. They emphasize the need to help students develop the processes that are the major means for doing mathematics, thinking about mathematics, understanding mathematics, and communicating mathematics.

Students will use data gathered to determine the effects of population changes on the surrounding area using a mathematical model to support their conclusions. In written form, they will communicate the impact of these changes. Students also will communicate with people using a written/verbal survey. They will think about the impact of these population changes in many different areas such as economics, government, environment and the overall social ramifications of an area being studied. Last of all, students will use different avenues to display and communicate the processes they went through to arrive at their conclusions.

- **Patterns, Functions, and Algebra**

Students will see a pattern in the change of population and make predictions based on those patterns.

- **Geometry and Spatial Sense**

Students will measure the space it takes for an individual to maintain its life.

- **Measurement**

Students will measure populations. They will measure the height of plants and the area that the plants occupy.

- **Data Analysis, Statistics, and Probability**

Students will determine mean, median, and mode for a set of data representing a population. They will analyze different survey methods and design their own survey.

Links to Maryland High School Mathematics Core Learning Goals:

Functions and Algebra

- **1.1**

Students will recognize, describe, and extend patterns and functional relationships that are expressed numerically, algebraically, and geometrically. (1.1.1, 1.1.2, 1.1.4)

- **1.2**

Students will model and interpret real-world situations, using the language of mathematics and appropriate technology. (1.2.1, 1.2.4)

Geometry, Measurement, and Reasoning

- **2.3.2**

Students will use techniques of measurement and will estimate, calculate and compare perimeter, circumference, area, volume, and surface area of two-and-three dimensional figures and their parts. The results will be expressed with appropriate precision.

Data Analysis and Probability

- **3.1**

Students will collect, organize, analyze and present data (3.1.1, 3.1.2, 3.1.3)

Links to National Science Education Standards:

- **Unifying Concepts and Processes**

Students will be able to see the big picture of human population by using modeling of plant population and smaller scale human populations.

- **Science as Inquiry**

Students will use the scientific method to hypothesize, analyze, and draw conclusions about a given situation.

- **Life Science**

Students will study two systems of population and the dynamics of those systems.

- **Science in Personal and Social Perspectives**

Students will be thinking about the effect a changing population has on the social conditions of the area that they live in and the demands on various resources of that area.

Links to Maryland High School Science Core Learning Goals:

- **Concepts of Biology**

Students will be dealing with plants and the changes that they undergo through their lifespan and the things necessary to make them grow. Students also will be dealing with the concept of life in general and how it is affected by the possibility of overpopulation.

Grade/Level:

Grades 7-12

Duration/Length:

2-3 weeks to collect plant data, 6-7 days of class instruction/activities

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- TI-83 graphing calculator skills
- Basic measuring techniques
- How to write a lab report
- How to keep a lab journal

Student Outcomes:

Students will be able to:

- draw conclusions based on data about population density and how this affects the population itself.
- represent variations in population both mathematically and graphically.
- make a connection between a population's demand on the resources around them, whether it be a human population drawing on natural resources or a plant population drawing on soil nutrients and water.
- design, conduct, and analyze ways of gathering data.
- analyze representations of data.
- use the statistical analysis functions of a TI-83 graphing calculator.

Materials/Resources/Printed Materials:

- Potting Soil
- 15 plant bulbs, possibly marigolds, corn, grass or tomatoes, or rock daffodils
- 5 medium sized flowerpots
- Graphing calculator (TI-82/83)
- Meter Stick
- Internet access

Development/Procedures:

Activity 1: Plant Growth

Two - three weeks prior to the week the lesson is to be started, teacher should have the students use the flowerpots to plant flower bulbs in each pot respectively. Students will water and tend to each of the pots exactly the same way each day. Each subsequent day, the students will record in their journals any observations that can be made about each pot. The observations should include such things as how many plants came up, how high they have grown, and their overall appearance.

Day 1

Teacher should lead a discussion to inform students of what a census is and how it is conducted. This can be done by discussing with the students various methods of counting a population. Discuss why a census is important and some of the impacts changes in population have on an area.

Day 2

Teacher should have students use the Internet site "www.census.gov" to find the results of the last ten census that have been conducted. Based on the discussion of population changes and the information gathered from the Internet, have the students write a hypothesis about the relationship between population changes and the demand these changes make on the various resources of an area. Make sure the students understand that the plants are drawing on resources available to them, such as soil nutrients and water, just as humans draw on resources in the areas where they live.

Day 3

Activity 2: Create and Conduct Survey

Students will work in cooperative groups to create an effective survey to collect yearly population data of their household from the time the student was in kindergarten to their current age. The survey should only include people that were and are living in the same household as their parent(s)/guardian.

The surveys should include number of people and age of each person in that household from the time the student was in kindergarten to their current age. Students should then present the surveys to the class. As a class, students should choose one of the examples of the surveys to use as a model to conduct the actual survey. Allow the students 2-3 days to complete these surveys.

Day 4

Teacher should lead a discussion about data analysis with students. This discussion should include topics such as mean, median, and mode. Teacher should use data that was gathered on Day 2 or population data from “The World Almanac and Book of Facts 1996” to illustrate these three concepts. Give the students three sets of data. Have the students find the mean, median, and mode of the first two sets of data using pencil and paper. Have students use graphing calculators to find the mean, median, and mode of the third set of data.

How to find mean, median, and mode using a TI-83 graphing calculator

Press **STAT** button, then the number **5** to select **5:SetUpEditor**. **SetUpEditor** is pasted to the home screen. Press **ENTER**. Press **STAT**, then the number **1** to select **1:Edit**. Now enter the population of each census year into **L1**. Press **STAT**, then move cursor to **CALC**. Press **1** to select **1:1-Var Stats** and press **ENTER**. Press **2nd** and then **1(L1)** and then press **ENTER**. This will result in a screen that lists the mean, median, and mode of **L1**.

Day 5:

Activity 3: Analyze Past Census

Teacher should lead a discussion of scatter plots with the students. Teacher should use data that was gathered on Day 2 or population data from “The World Almanac and Book of Facts of 1996” to illustrate this concept. Illustrate a scatter plot with the students using the last ten census. The example should take into consideration the number of people per year of census. Illustration should include a line of best fit. Give the students three sets of data. Have the students create a scatter plot of the first two sets of data using pencil and paper, use a graphing calculator to create a scatter plot of the third set of data, and analyze the correlation of data.

How to create a scatter plot using a TI-83 graphing calculator

Press **STAT**, then the number **1** to select **1:Edit**. Use arrow keys to go to **L1**, then press **CLEAR**. Now enter into **L1** the census years. Enter into **L2** the population in those years. Press **2nd**, press **Y=(STAT PLOT)**, move cursor down to **ON**, press **ENTER**, move cursor down to **TYPE**, then over to diagram of scatter plot graph. Verify **XList** reads **L1** and **YList** reads **L2**. Move cursor to down select **MARK**. Make a choice of mark. Press **ZOOM**, then **9** to select **9:ZoomStat**. This will result in a scatter plot of your data.

Day 6:

Activity 4: Analyze Survey

Students should bring in data collected from their surveys. They should combine all the data sets in the class into one data set. Students should use the concepts discussed during the previous two classes to analyze their data. They also should create a line of best fit for their scatter plot of survey data. Students should discuss whether or not their data supported their original hypothesis. The analysis should take into consideration the number of people in this population per year.

How to create a line of best fit using the TI-83 graphing

Press **STAT** and move the cursor to the **CALC** menu. Press **4** to select **4: LinReg(ax+b)** and enter **L1, L2** by pressing **2nd 1(L1)** and **2nd 2(L2)**. Then press **Enter**. This results in the equation that fits your data. Press **Y=** and clear any previous graphs by moving the cursor to the equation and pressing **CLEAR**. Press **VAR** and then press **5** to select **5:Statistics**. Move cursor over to **EQ** and then press **1** to select **1:RegEq**. The equation should be pasted in **Y=list of equations**. Press **GRAPH** to see the line of best fit and the scatter plot. The line of best fit will allow you to make predictions based on the data. To do this, press **TRACE**. Then move cursor to the line of best fit. As the cursor moves along the line, you can see the relationship of X and Y.

Day 7:**Activity 5: Analyze Plant Data**

Students should analyze plant data using the same methods that were used to analyze the survey and past census. This analysis should take into consideration the average height of plant growth in each pot, as well as the number of plants that came up per the number of bulbs planted.

Assessment:

The teacher should have the students write a lab report that consists of a hypothesis, materials, procedure, data, results, analysis, and error section in the report. In the lab report, the student should demonstrate a solid grasp of the scientific method. The emphasis of the report, should be placed on the hypothesis, data, results, and analysis section of the report. Students should demonstrate that they not only understand what happened in the activity but why it happened. A scoring rubric is provided for the teacher.

Extension/Follow Up:

The students could do a box(box and whisker) plot with the data that they gathered from their survey and plant data. The teacher may want the students to find the www.census.gov website using the search engine www.altavista.com.

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SCORING RUBRIC

- 4
- Student shows a good understanding of the scientific method, not only knows what happens, but is able to explain in detail why it happened. Report and journal is highly organized and well presented.
 - The hypothesis is stated clearly.
 - Extrapolations from the data are made and justified.
 - Terminology is used correctly.
 - Calculations are done correctly.
 - Graphs are labeled correctly.
 - The relationship between the dependent and independent variables is clearly and accurately described.
 - Appropriate scale is used on each axis depending on the range of the data for that axis.
- 3
- The hypothesis is stated clearly.
 - Extrapolations from the data are made and justified.
 - Graphs are labeled correctly.
 - The relationship between the dependent and independent variables is clearly and accurately described.
 - Scale is used but is not appropriate.
- 2
- The hypothesis is stated but not clear.
 - Extrapolations from the data are made but not justified.
 - Graphs are labeled.
 - The relationship between the dependent and independent variables is stated but not accurately described.
- 1
- The hypothesis is stated but not clear.
 - Extrapolations from the data are made but not clear.
 - Graphs are not labeled.
 - There is no attempt to explain the relationship between the dependent and independent variables.
- 0
- Many key components are missing.